GROUP EFFECTIVENESS RESEARCH LABORATORY

Department of Psychology

University of Illinois

SOCIAL PERCEPTION AND GROUP EFFECTIVENESS

ANNUAL STATUS REPORT

February 15, 1954

Contract N6ori-07135, Project NR 170-106

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I. General Nature of the Program

Purpose. This project has two major aims: (a) to identify psychological variables which differentiate effective and ineffective teams, and (b) to develop theoretical principles and concepts to aid in the prediction of team effectiveness, and in the assembly of productive teams.

We recognize that the skills and abilities of individual team members are important components of team effectiveness. However, we also regard team effectiveness as dependent on the ways in which the team members perceive and interact with each other.

We have thus been studying the effects of interpersonal perception on team productivity. Our particular emphasis has been on the effects on team productivity which a person has who tends to perceive similarities or differences in personality among his co-workers. These perceptual tendencies have been measured by Assumed Similarity scores which are described below.

II. Measurement of Assumed Similarity

Test items and administration. To obtain Assumed Similarity (AS) scores, we typically present the Subject (S) with a list of statements descriptive of interpersonal behavior. We have used items such as, "I am usually quick to lose my temper," or "I prefer staying at home to going to a movie." S answers each of these items on a six point scale which ranges from definitely true to definitely untrue. We have established that the tendency to assume similarity between persons is a generalized set which is virtually independent of the specific content of the items which constitute the test (See Technical Report No. 7).

Scoring of ASo. The score which we have derived from this test has been called Assumed Similarity between opposites (ASo). It requires that S fill out the test questionnaire twice: first as his most preferred co-worker would describe himself, and second, how his least preferred co-worker would describe himself. These two predictions are then compared by the statistic *D* (cf. Cronbach and Gleser, Technical Report No. 2; also Osgood and Suci[1]).

Reliability of ASo. We have used tests ranging in length from 40 to 80 items. The reliability of the ASo scores derived from a typical 60 item test is in the neighborhood of .90. The degree to which a person differentiates others thus appears to be a stable measure of a general trait of his personality.

Interpretation of ASo. No consistent relationships between AS scores and the usual personality test traits have been found despite a number of attempts. Scattered indications in studies of AS suggest, however, that a person who assumes much similarity (i.e., has high ASo) is more acceptant and pliable, prefers informal, personalized relationships, and is less critical of others. On the other hand, the person who assumes little similarity (i.e., has low ASo) tends to be more analytic and manipulative, and prefers more formal interpersonal relations.

1/ Osgood, C. E., and Suci, G. A measure of relation determined by both mean difference and profile information. Psychol. Bull. 1952, 49, 251-262.

III. Prediction of Group Effectiveness

Work with Informal Teams

Two studies of team effectiveness were reported last year. These dealt with informally organized groups, namely, two samples of high school basketball teams[2] and one group of student surveying parties[3].

We found that effective teams differed from ineffective teams in the type of preferred co-workers which the team members chose. Effective teams tended to prefer co-workers with low ASo, i.e., persons who perceived relatively large differences between those whom they preferred and those whom they did not prefer as work-companions. Less effective teams, on the other hand, chose as preferred co-workers persons who saw little difference between those whom they preferred and those whom they did not prefer as work-companions. Most preferred co-workers of ineffective teams thus tended to have high ASo.

The results of these studies were reported in Technical Reports 3 and 6, and are here summarized in Table 1.

2/ Basketball Team Study

a. Sample I: 14 high school teams tested at the beginning of the season. 9-18 men per team.

Criterion: Proportion of games the team won by mid-season.

Predictor tests: Assumed Similarity and Sociometric scores were obtained from each S. ASo of most preferred co-worker was correlated with criterion.

b. Sample II: 7 good, 5 poor high school basketball teams tested at the end of the season.

Criterion: Proportion of games won by end of season, exclusive of tournaments.

Predictor tests: Same as in Sample I.

3/ Surveying teams

Sample: 22 parties, consisting of 3-4 men, each.

Criterion: Instructor's rating of team accuracy on assigned surveying tasks.

Predictor: ASo of teams' most preferred co-worker.

Table 1

Correlation of the Team's Most Preferred Co-Worker's ASo with Team Effectiveness in Three Samples of Informal Teams

Sample	Criterion	Statistic	Correlation*	N	P
Basketball teams I	% games won at midseason	Rho	-.69	14	(.01)**
Basketball teams II	% games won at end of season	r_{pb}	-.58	12	.05***
Surveying Teams	Instructors' Ratings of Team Accuracy	r	-.51	22	.025***

* The minus correlation indicates that the effective team's most preferred co-worker (MPC) tended to perceive little similarity; the ineffective team's MPC tended to perceive much similarity between his preferred and not preferred work companions.

** As this study was exploratory, ordinary tests of significance do not apply. A Rho of this magnitude would otherwise have $P < .01$.

*** One tailed tests

As can be seen, ASo and team effectiveness criteria correlate significantly in the same direction in all three samples.

In view of these findings, we extended our investigations to formally organized teams.

Work with Small Formal Teams - Military Units

We were fortunate to find two groups of small military units which met the requirements for our studies: (a) they were available in sufficient number, and (b) adequate criteria of group effectiveness could be obtained.

The first of these groups consisted of 70 B-29 bomber crews, from four training classes at Randolph Air Force Base, Texas. The second sample,

used for validation purposes, consisted of the 25 Army tank crews which participated in Project STALK, an experiment conducted by OCAFF and the Ballistics Research Laboratories. HumRRO Unit No. 1 was given responsibility for studying the psychological factors involved in the problem. We are here presenting some of the data in preliminary form; a forthcoming technical report will describe these two studies in detail.

B-29 Bomber Crews[4]. A B-29 crew normally consists of 11 crew members, commanded by the Aircraft Commander (AC). Five of these crew members are officers, and six are enlisted men.

A total of 70 crews were tested. A number of Ss were absent from testing sessions, and criteria were incomplete for several other crews. Some 50 crews were therefore available for analysis.

The two main criteria of B-29 crew effectiveness were (a) Radar Bomb Scores (RBS), a hypothetical circular error average based on simulated radar bomb runs, and (b) Control Time Error (CTE), a navigational criterion based on the average time error with which a plane arrives at a specified point. According to the Crew Research Laboratory, CTE is almost entirely a function of the Navigator.

On the basis of our studies of informal teams we hypothesized that the ASo of the formal leader would be negatively correlated with crew effectiveness. While we found a marginally significant correlation between ASo_{AC} and RBS ($r = -.24$, $N = 53$, $P = .05$ one tailed), the correlation between ASo_{AC} and CTE was not significant ($r = .16$, $N = 51$). Further analysis showed that the correlation between ASo_{AC} and RBS varied greatly from class to class (rho's ranged from -.72 to .55). We therefore concluded

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4/ This study was jointly sponsored by ONR and the Crew Research Laboratory of HRRC. We are particularly indebted to Dr. Robert L. French, Director of Research, CRL, and Dr. Thornton B. Roby, Chief, Crew Assembly Section, for their support and guidance throughout this study.

that neither the RBS nor the CTE sub-hypotheses were supported. This negative finding raised the question whether the "informal leader" in our earlier studies is in an analogous position to the formal leader in the B-29 air crews. In the basketball and surveying teams the "informal leader" was operationally the most-preferred co-worker; this suggests that a mutually accepting interpersonal relationship between the leader and his team is important in team effectiveness. We therefore re-examined the relationship of ASo to team effectiveness criteria under selected sociometric conditions. In particular, we considered the relations between the leader and his "key-men" (i.e., the crew members who are functionally involved in tasks which are reflected in the criterion measures). In the Radar Bomb Score (RBS), for example, the Radar Observer (VO) and the Navigator (N) are considered to be the key men. Table 2 shows that the relationship between ASo_{AC} and RBS is high and negative for those crews where the AC is most preferred co-worker (i.e., is both formal and informal leader) and sociometrically chooses the VO and/or N. The cross validation reported below is relevant only to this sociometric condition. Research investigating the other sociometric conditions is now in progress.

Table 2

Correlation of the Aircraft Commander's ASo Score with Radar Bomb Score Criteria under Selected Sociometric Relations between the Aircraft Commander and the Keymen

Sociometric Condition	Rho	N	P
AC = MPC $\rightarrow$ VO and/or N	-.78	15	(.01)*
AC = MPC $\not\rightarrow$ VO and/or N	.64	9	
AC $\neq$ MPC $\rightarrow$ VO and/or N	-.19	24	--
AC $\neq$ MPC $\not\rightarrow$ VO and/or N	-.67	7	--

AC = Aircraft Commander
VO = Radar Observer
N = Navigator
MPC = Most Preferred Crew Member
$\rightarrow$ chooses sociometrically
$\not\rightarrow$ does not choose

* As this study was exploratory, ordinary tests of significance do not apply. A rho of this magnitude would otherwise have $P < .01$.

The Navigator is the keyman for CTE. The relationship between the ASo_{AC} and CTE is high and positive for those crews in which the AC is most preferred crew member (.62, N = 22, P >.01). Where the AC = MPC and chooses the Navigator it is .45 (N = 7), which is contrary to the findings obtained with RBS. RBS and CTE are, however, uncorrelated, and, according to previous Air Force studies as well as interview material from former B-29 personnel, the tasks involve basically different operations. Further analysis suggests that the Navigator's ASo is negatively related to CTE (-.38, N = 7) in those crews in which the AC = MPC and chooses the Navigator. Taken together, these two findings may mean that operations involved in CTE require the Navigator to assume the leadership role and that the Aircraft Commander have a relatively pliant, accepting attitude as reflected by ASo. This raises the question whether a particular combination of crew members can be at once highly effective in both RBS and CTE. We are pursuing this question in further research.

Tank Crews[5]. The sample consisted of 25 tank crews which participated in project STALK. This project had as its main purpose the comparative evaluation of five models of tanks. The present study was only one of a number of investigations which STALK provided with an opportunity for research.

The experimental design of STALK consisted of a modified Graeco-Latin Square. Five platoons consisting of five crews each were systematically rotated over five models of tanks. Thus, each crew worked with each of five tanks during the five phases of the experiment.

The following two criteria appeared appropriate for validating our findings with RBS in B-29 bomber crews.

5/ This study was made with permission of the Director, Ballistics Research Laboratories, Aberdeen, Md., and Mr. Floyd I. Hill, Technical Director of STALK. We are especially indebted to Messrs. Hill, Andrew J. Eckles, III, and Stanford C. Ericksen, whose active collaboration enabled us to conduct this study.

(a) Time per Hit (T/H): A gunnery score indicating the average time required to hit 25 targets, the gunner being the keyman.

(b) Travel Time (T/T): The average time required to drive the tank from one target to the next, the tank driver being the keyman.

Time per Hit and Travel Time are uncorrelated criteria (-.07, N = 25) when we sum the scores over all phases. As will be recalled, the ASo of the Aircraft Commander correlated negatively with the RBS criterion where the AC was the most preferred crew member and endorsed the keymen. Two similar hypotheses could here be tested:

(a) the Tank Commander's ASo should correlate negatively with Time/Hit in crews in which the Tank Commander is most Preferred Crew Member (MPC) and sociometrically chooses the Gunner.

(b) the Tank Commander's ASo score should correlate negatively with Travel Time in crews in which the Tank Commander is Most Preferred Crew Member and endorses the Driver.

Table 3 shows the correlation of the Tank Commander's ASo (ASo_{TC}) and the mean criteria over all phases, for those crews to which our hypotheses applies.

Table 3

Correlations of the Tank Commander's ASo Score with Effectiveness Criteria where the Tank Commander is Most Preferred Crew Member and Endorses the Keyman

Sociometric Condition	Criterion	Rho	N**	P
TC = MPC → G	Combined Time per Hit	-.76	7	.05*
TC = MPC → D	Combined Travel Time	-.30	6	

TC = Tank Commander
MPC = Most Preferred Crew Member
→ = Chooses sociometrically
G = Gunner
D = Driver

* One-tailed test
** One crew is common to both samples

As can be seen, the hypothesis is supported at a statistically significant level for the Time/Hit criterion. The correlation for the Travel Time criterion is not significant although in the same direction. We therefore conclude that the Assumed Similarity score, ASo, predicts effectiveness of formal teams in which (a) the leader is also the informal leader and (b) in which the leader endorses the person who is keyman on the criterion-relevant operation.[6]

Relation of Interpersonal Attitudes to Utilization of Individual Skill. The interpersonal relationship between leader and keyman has been shown to be important in the prediction of team effectiveness from leader attitudes. We have also considered the possibility that it may be important in the utilization of the keyman's proficiency. Preliminary analyses of available data suggest that the team utilizes the available skill of its members only under certain conditions of team structure. We are now planning studies to explore this problem further.

We may conceptualize our present position formally by the expression

$$TE_c \, f \, (IPR_{Lk} \supset Att_L \cdot P_k)$$

where TE_c = Team effectiveness as measured by a criterion, c

IPR_{Lk} = Favorable Interpersonal Relationship between leader and keyman

Att_L = The leader's attitude, as measured by ASo

P_k = The proficiency of the keyman

6/ Other operational definitions of favorable interpersonal relationships should be investigated. Thus, in B-29 and Tank Crews we obtain essentially similar, although somewhat lower, relations between the leader's ASo and team effectiveness where the leader and keyman mutually choose each other.

In other words, team effectiveness is a function of the leader's ASo and the proficiency of the keyman provided that a favorable interpersonal relationship between the leader and his keyman is present.

It may be noted that this formulation is equally applicable to informal teams. Here the informal and formal leader is by definition the same person. If there is no specialization any team member may of course act as the person analogous to the keyman in formal teams.

IV. Methodological Studies

Several basic methodological studies were completed during the last report year. Three of these have been distributed as Technical Reports.

Theory of Measurement of Profile Similarity

1. Technical Report No. 2 (1952) presented a general theory for measuring profile similarity. This report has been revised and additional findings have been included. The revised form was published under the title, "Assessing Similarity between Profiles" by Cronbach and Gleser in the Psychological Bulletin, 1953.

2. W. G. Warrington's study, comparing three test designs for measuring similarity between persons, has been distributed as Technical Report No. 8. Major findings of the study were discussed in the previous Annual Status Report (1953).

3. Technical Report No. 7 reports further investigations of Assumed Similarity measure ASo. The study, by Cronbach, Hartmann, and Ehart, concluded that ASo measures a general attitude or mental set which is essentially independent of the test item content.

4. S. A. Rudin and Melvin Manis have shown that ASo can be measured with Osgood's Semantic Differential Test. The usual personality items as well as Semantic Differential items were administered to two samples of 40 and 52 Naval ROTC students.

The correlations between ASo obtained with Semantic Differential items and that obtained by the usual statements is .78 and .66 in the two independent samples. The split-half reliability of the AS score using Semantic Differential items is .94 for each sample (N = 40 and 52).

Analysis of Predictive Accuracy and Assumed Similarity. A study of the mathematical properties of "Accuracy of Prediction of Others," and Assumed Similarity, as conventionally measured, was commenced in June by Cronbach and Ehart, using illustrations from data supplied by Bronfenbrenner.

In its present form, the study has isolated twelve logically distinguishable components of the Accuracy score, and four for the Assumed Similarity score. Reliabilities and intercorrelations of the components are being determined. The analysis indicates that an important aspect of social perception is the judgmental frame or unconscious theory of personality used by the perceiver. This study is also expected to have implications for clinical diagnosis and personality assessment.

V. Future Plans

We have recently begun testing the generality of our hypotheses by extending our studies to industrial organizations. In particular, we intend to work with planning and decision-making groups.

A study of open-hearth supervisory personnel of a large steel company is now in progress. In this study we hope to test the generality of hypotheses which have emerged from the B-29 and Tank studies and to investigate hypotheses related to co-operation among individuals who are of equal rank in the supervisory structure.

VI. Publications

Technical Reports

No. 1 Fiedler, F. E., Warrington, W. G., and Blaisdell, F. J. Unconscious attitudes as correlates of sociometric choice in a social group. J. abnorm. soc. Psychol., 1952, 47, 790-796.

No. 2 Cronbach, L. J., and Gleser, Goldine C. Similarity between persons and related problems of profile analysis. Psychol. Bull. 1953, 50, 456-473.

No. 3 Fiedler, F. E., Hartmann, W., and Rudin, S. A. The relationship of interpersonal perception to effectiveness in basketball teams.

No. 4 Rudin, S. A., Lazar, I., Ehart, Mary E., and Cronbach, L. J. Some empirical studies of the reliability of social perception scores.

No. 5 Hohn, F. E. The comparison of sociometric matrices. With a discussion by L. J. Cronbach.

No. 6 Fiedler, F. E. Assumed similarity measures as predictors of team effectiveness in surveying.

No. 7 Cronbach, L. J., Hartmann, W., and Ehart, M. . An investigation of the character and properties of assumed similarity measures.

No. 8 Warrington, W. G. The comparative efficiency of three test designs for measuring similarity between persons.

Supplemental Report No. 3 Fiedler, F. E., Hartmann, W., and Rudin, S. A. Correction and Extension of "The relationship of interpersonal perception to effectiveness in basketball teams."

Supplemental Journal Publications

Fiedler, F. E. Psychological distance dimension in interpersonal relations. J. Pers. 1953, 22, 142-150.

Fiedler, F. E. Assumed similarity measures as predictors of team effectiveness. J. abnorm. soc. Psychol. 1954, in press.

VII. Professional Personnel

Currently employed:

Fred E. Fiedler, Assistant Professor of Psychology, Project Director

Dorothy McBride, Research Associate, Assistant Project Director

Walter A. Cleven, Research Assistant

Elaine M. Osler, Secretary

Joyce Pye, Statistical Clerk

Employed during the last year

Lee J. Cronbach, Professor of Education
Project Director, Sept., 1951 - August, 1953

Irving Lazar, Instructor

George S. Leavitt, Research Associate

Walter Hartmann, Research Associate

Vivian A. McCraven, Research Associate

Stanley A. Rudin, Research Assistant

Mary E. Ehart, Research Assistant

Ralph E. Smith, Statistical Clerk

Fred E. Fiedler
Principal Investigator